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APPLICATION NUMBER: 60/474,445  
FILING DATE: May 30, 2003  
RELATED PCT APPLICATION NUMBER: PCT/US04/16338

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PTO/SB/16 (10-01)

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**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.

EL 449 549 893 US

**INVENTOR(S)**

Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)
Timothy	Flannery	McKee, Kentucky

☐ Additional inventors are being named on the \_\_\_\_\_ separately numbered sheets attached hereto**TITLE OF THE INVENTION (500 characters max)**

Adjustable Extruder Die

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864 422 3517**ENCLOSED APPLICATION PARTS (check all that apply)**☒ Specification Number of Pages10☐ CD(s), Number☒ Drawing(s) Number of Sheets6☐ Other (specify)☐ Application Data Sheet. See 37 CFR 1.76**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT**☐ Applicant claims small entity status. See 37 CFR 1.27.☐ A check or money order is enclosed to cover the filing fees☒ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number:13-3085☐ Payment by credit card. Form PTO-2038 is attached.FILING FEE  
AMOUNT (\$)\$160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.☐ Yes, the name of the U.S. Government agency and the Government contract number are: \_\_\_\_\_

Respectfully submitted,

SIGNATURE

Felipe J. FarleyDate 05/30/2003TYPED or PRINTED NAME Felipe J. FarleyTELEPHONE 864 422 4223REGISTRATION NO.  
(if appropriate)  
Docket Number:38,445P50-0108**USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT**

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

## Variable Dies

### Drying process of synthetic elastomers.

This technology utilizes two extruders in series. (see annex 1) :

- The expeller : The first extruder squeezes the rubber & reduces the moisture content of the rubber from 60 to 15%
- The expander : The second extruder increases the rubber pressure and temperature, thus creating a super heated liquid, in order to flash the water at the end of the screw and to decrease the moisture (volatile matter VM) from 15% to 2%.
- The flash corresponds to a very rapid change of state (liquid-Vapor) through the dies, induced by the fact that the return to atmospheric pressure happens when the water temperature is still significantly higher than 100 Celcius.  
The Anderson die is caraterized by its geometry (hole, cross, ...) and by consequence by the pressure drop induced when the rubber goes through it.

The variable die is an evolution of the type of dies used on the expander head.

### B Expander process .

- The energy necessary to produce the flash, is transferred to the rubber from the screw in the expander. This transfer of energy is made possible by the resistance of the rubber to exit the expander through the dies. The temperature & pressure reach a maximum at dies.
- For a given screw speed and rubber flow rate the resistance, and therefore the amount of energy transferred to the rubber, is dependent on the pressure at the head.
- This pressure is fixed by the pressure drop induced by the passage through all the dies. The dies arrangement (quantity of dies, geometry, size,...) is called « dies set up ».
- When the rubber goes through the dies, the flash is « usually » associated with rubber decohesion creating crumbs. These crumbs are carried to balers.
- The control of the crumb size is a key to ensure a good rubber transportation and by consequence a reduction of conveyors fouling (crumbs too small).

### C Variable die principle.

❖ *The current dies have 2 major drawbacks :*

- The optimization of the pressure at the head requires a production shutdown in order to change the number and/or size of the dies.
- Pressure and Crumbs are both dependent on the dies set up and for some elastomers, it is not possible to optimize these 2 functions.

❖ *In the case of the variable die*

- The pressure drop necessary to obtain the head pressure is a function of the rubber passage trough the « variable space ». The addition of a mechanical device to move the adjustable die allows the following :
  - Remote modification of the « variable space » and therefore of the head pressure, with no need to shutdown the expander process.

- Ability to optimize the expander process in real time with instant feed back from changes made.
- The flash and the decohesion of the rubber is provided by the « turbulence chamber ». This chamber (empriquely designed) is where a 1" flash occurred which assure a turbulent system before the rubber goes through the « flash channel ». The « turbulence chamber » is required to set independantly the pressure and the crumb shape. A minimum volume of this area is maintained whatever the closure of the « variable space ».
- The crumb size is defined by the set up, the thickness and the size of the « flash channels ». Each elastomer is associated a specific « flash disk » design.

#### **D. Inventor :**

Tim Flanery. Employee of American Synthetic Rubber Corporation (Louisville, KY).

#### **E. Application scope**

This variable die can be used on every expander whatever the technology is (Anderson, Welding, FOM,...). In our process, the expander is equipped with 4 variable dies. This permits a smaller rubber flow through each die and therefore lowers the stress on each dies mechanical components. (see attached picture).

#### **F Point d'avancement.**

The variable die as defined in annex 2 should not significantly change in its principle. The results are outstanding.

#### **❖ Annexes :**

Annexe : Variable die drawing

## **Adjustable Dies on NBU Expander**

### **Operation:**

The adjustable dies allow the expander head opening to be changed without shutting the line down. This should prove to be an advantage over the current system of changing the expander head size by changing dies.

- **To raise the head temperature, lower the die opening.**
- **To lower the head temperature, raise the die opening.**

Until we have gained some experience with how much of a difference a given change makes, it is recommended that changes be made in increments of no more than 3.

The die opening is controlled from the panel on the die plate control box. The panel is the same type as is used on the expeller chokes. To change the die setting do the following:

1. Press Menu on the control panel
2. Press 1 to get to the setting menu
3. Enter desired setting & press enter

Any setting from 3 to 95 may be entered using the key pad. These numbers are the number of turns the drive shaft makes, and it takes 20 turns of the shaft to get one turn on the dies. The dies are closed on a setting of 0 and open 5 turns on a setting of 100; this is the full operating range. A range of 3 to 95 has been set for operation to prevent possible damage to the gears.

The set point required for operation will vary depending on line rate & other factors, but will probably be in the 10 to 20 range.

A toggle switch with the settings off - auto - open is used to open the head temporarily. While running if the switch is set to open, the dies will begin to open and will continue until they reach a setting of 95 or the switch is returned to auto. When the switch is returned to auto the dies will return to their last setting. This feature may be useful if the line starts to "back-up".

A Key switch can be used to override all settings. This will only be used in an emergency.

**While operating, if the head temperature is too low set the set point to a lower setting. This will cause the dies to close. If the head temperature is too high raise the set point. This will cause the dies to open.**

## Specific Notes for NBU Adjustable Dies

### French Horn:

Continue to use the French Horn as you have been.

### 2304:

The adjustable head was used on 2300 with good results & it is believed that a similar effect can be obtained with 2304. In addition to the ability to be adjusted while running, the dies also have screen plates that can be changed when the line is down. These can be used to control the discharge characteristics (spraying) of the dies.

**2304 Up-Date:** It has been used successfully on 2304 since this was written. We will start with the 50 hole plate with 20 blocked giving a 30 hole plate.

### Maximizing Line Rate:

Past experience with other types on Line # 1, indicates the best way to maximize line rate using these dies is to:

1. Adjust dies to obtain proper head temperature (same temp. as regular head) at a normal line rate.
2. Increase line rate to the point that head temperature will fall too low.
3. Adjust die opening to obtain head temperature at the new higher rate.

Feel free to experiment, this is a new system & the best operating parameters have not been established. In all likelihood, adjustment of the French Horn in conjunction with the dies, will allow for better drying & increased production.

## Opening the Head

***As with all head openings, the possibility for unexpected release of steam and \ or hot rubber exists. It is therefore recommended that a rubber suit and face shield be worn to open any head, including the adjustable head.***

The adjustable head is opened in a similar manner to the regular SSBR head. The relief valve is opened, the four screen plates are removed from the adjustment sleeves & the head is ready to be run out.

**Do NOT use an impact wrench to remove or tighten the screen plate**

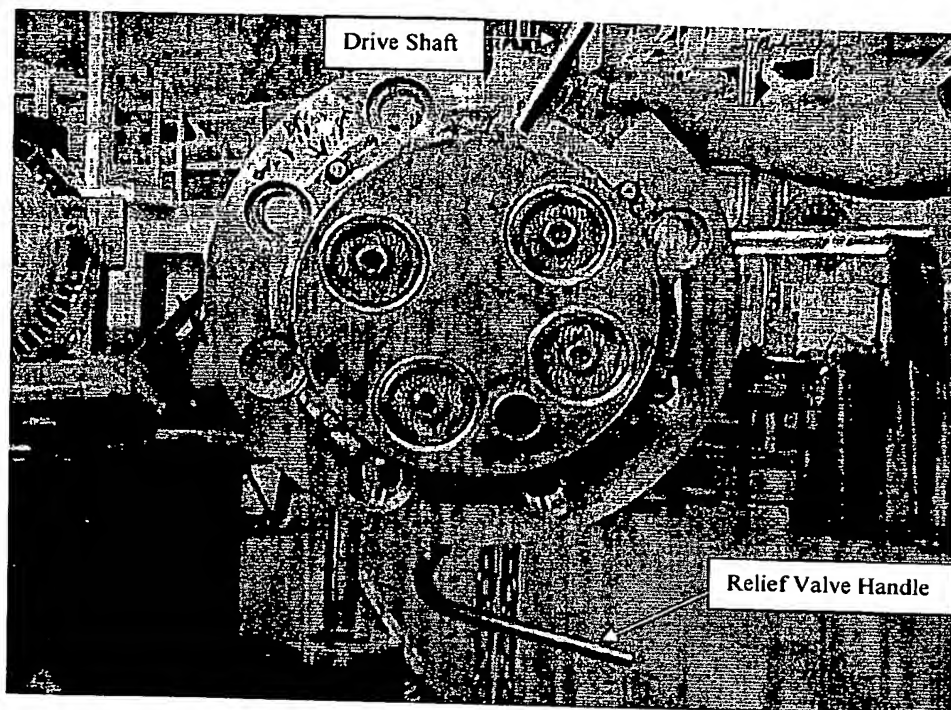
**Use of an impact wrench may damage gear train.**

**It is NOT necessary to home the dies after a head opening.**

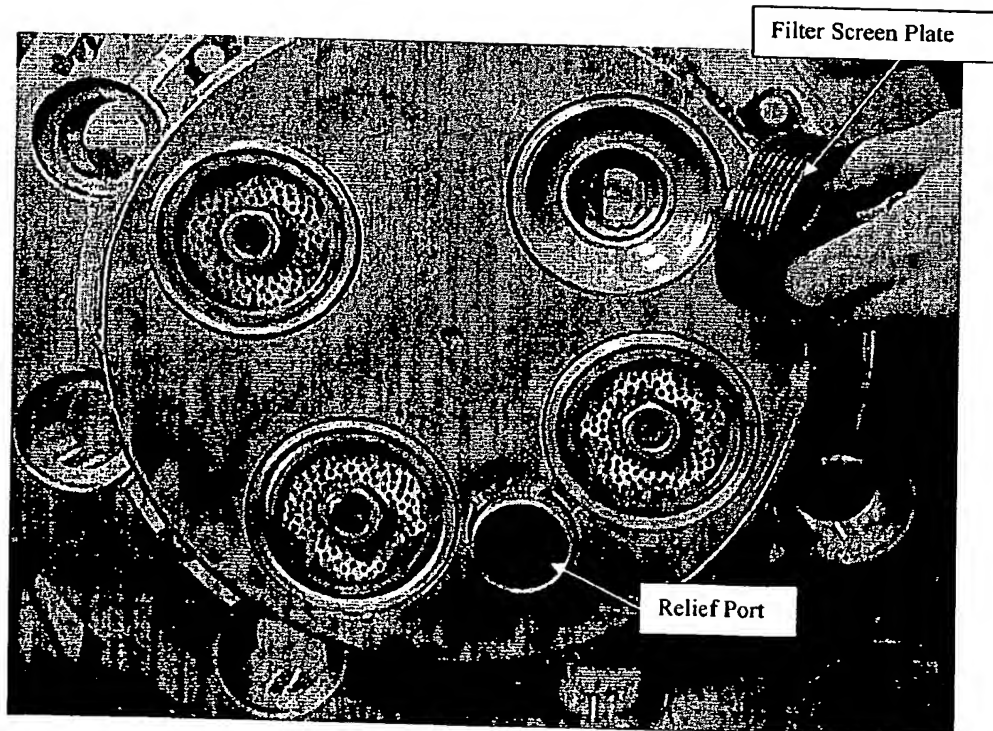
Homing is necessary only if the gears or drive shaft have been removed.

1. Shut down line & set the Expander jacket steam / water valve to water.
2. Make sure the pressure has been relieved, by opening the relief valve located on the bottom of the head. This should be opened as soon as possible after the line is down & left open until ready to restart. ***Remember that hot rubber & steam will blow out of the relief port when it is opened – Stay Clear.***
3. Comply with all Lock Out \ Tag Out procedures. The lock-out for the adjustable head motor is on the hand rail by the North-West corner of the hot box. Since this is a 90 vdc system, this switch is equivalent to a breaker for LO\TO.
4. Remove the four filter screens by using a 1-1/16" socket wrench on nut in center of filter screen. Check for contamination after the screen is removed.
5. Run out the expander head.
6. Clean & reinstall the filter screens. Tighten the screens securely, but remember that the gear train is holding the adjustment sleeve in place & over tightening can strip the gears. **Do NOT use an impact wrench.**
7. Close the relief valve.
8. Start the line.





NBU Adjustable Head



Removal of Filter Screen Plate



## Examples

Expander is running at 360 & we need 380 to dry. The current die setting is 22. All other parameters are OK.

Actions to take:

- 1) Press Menu on control panel
- 2) Press 1 for Settings. You should see a reading of, Current 22 New . Since the head temperature is too low, we will select a lower die setting.
- 3) Press 19 & then enter. This will change the setting from 22 to 19. You should see the needle on the amp meter jump up & then down to about 8 & then back to 0.

Had the head temperature been too high, a larger setting, 25 for example, would have been used.

In order to verify that the setting did change, do the following.

- 1) Press Menu on control panel
- 2) Press 3 for View. The setting should be displayed as 19. If it is not, then there may be a problem. Contact your Supervisor.

If the expander begins to "Back Up" the dies can be temporarily opened.

1. Turn the Auto – Off – Open switch to the Open position.
2. As the dies begin to open the expander hopper should clear.
3. Turn the Auto – Off – Open switch to auto.
4. The dies will automatically return to their setting.

The head will need to be opened if the filter screen is starting to plug.

To "Run without dies"

1. Follow the head opening procedure through step # 4.
2. After the filter plates are removed, the expander can be "Run without dies"

## Home the Dies

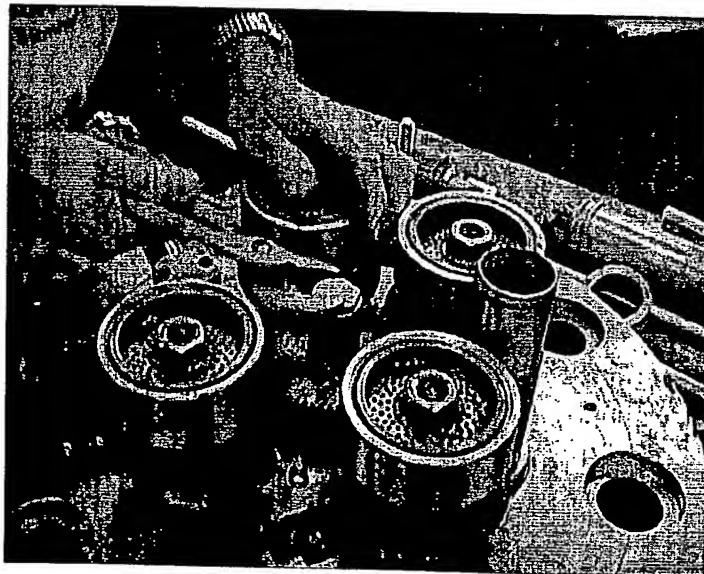
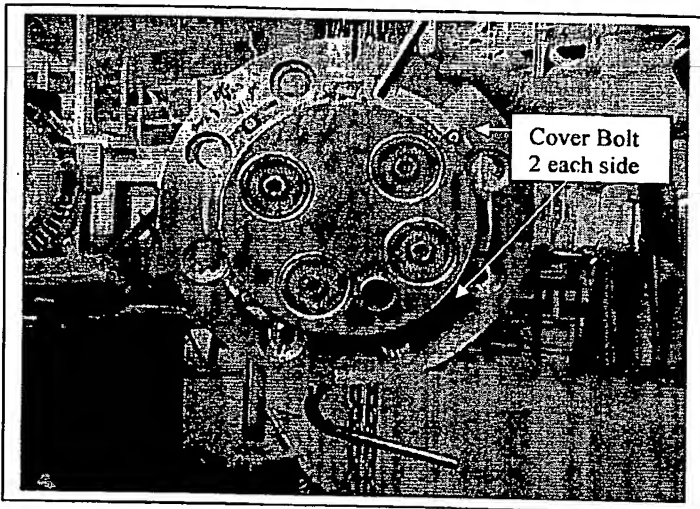
**It is NOT necessary to home the dies after a routine head opening**

**The dies need to be homed only if the drive train has been disconnected, or the center gear has been removed.**

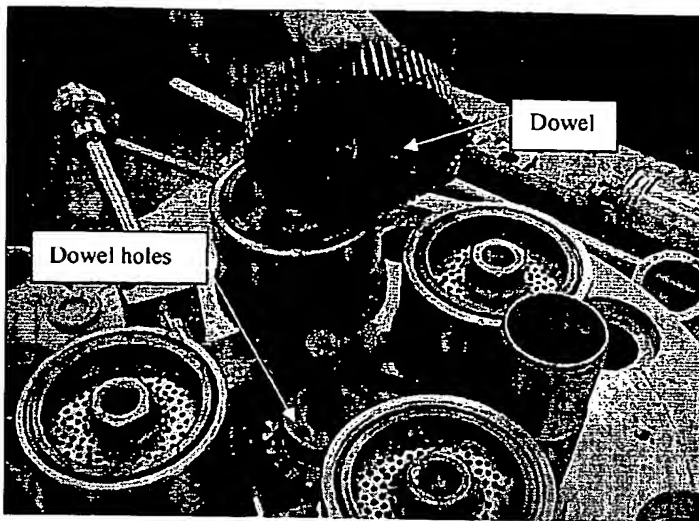
To Home the Dies do the following:

1. Place the Auto – Off – Open selector switch to the Off position. Leave it in this position until the end of this procedure.
2. Comply with Lock Out \ Tag Out for head opening
3. Remove the four cover bolts
4. Remove the cover.
5. Remove the center gear by removing the center bolt and pulling the spacer & gear out.
6. Remove the four adjustment sleeves and clean all rubber from inside them. You do not need to remove the die body from the head. The sleeve with the tapered bottom must be returned to the same position in the head. The taper provides clearance for the worm gear.
7. Securely tighten the clean filter screens into the clean adjustment sleeves. Lubricate the adjustment sleeve threads with high temperature grease.
8. Screw the adjustment sleeve & filter screen assembly onto the die body until it bottoms out against the die body. Do not tighten, it should just lightly touch the die body.
9. Install the center gear & spacer. It may be necessary to move the adjustment sleeves slightly to get the gears to mesh. Remember to align the dowel rods on the spur gear to the holes in the worm gear before trying to install the center gear.
10. Install the center bolt.
11. Install the cover & cover bolts.
12. Follow LO/TO procedures to unlock the power supply & restore power to the adjustable dies.
13. Press Menu on the control panel & select 2 to Home
14. Press 1234 & enter it for the password

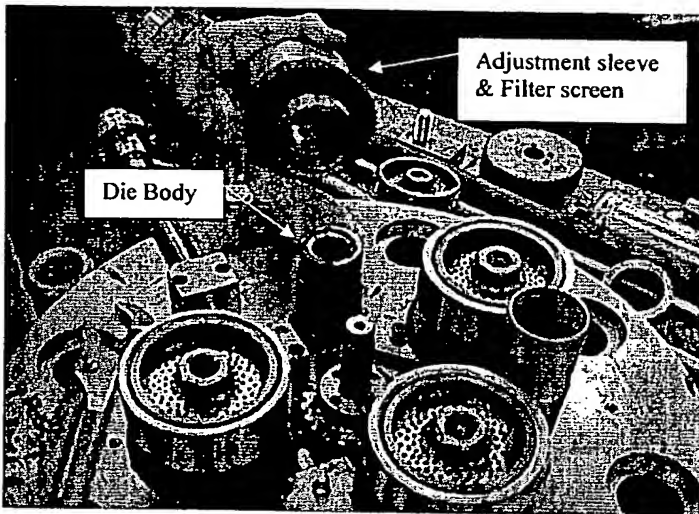
15. When Home dies at 0 appears on the screen, press 0 enter
16. Press Menu & select 3 to view the setting. It should show 0. If it does go on to step 17. If it does not, then repeat steps 13 thru 15. If it still doesn't show 0 contact your supervisor.
17. Press Menu & select 1 for settings. The current setting remains as it was, you should now enter the desired new setting.
18. Turn the Auto – OFF – Open selector to Auto. The dies will open to the new setting.



Center Bolt Removal

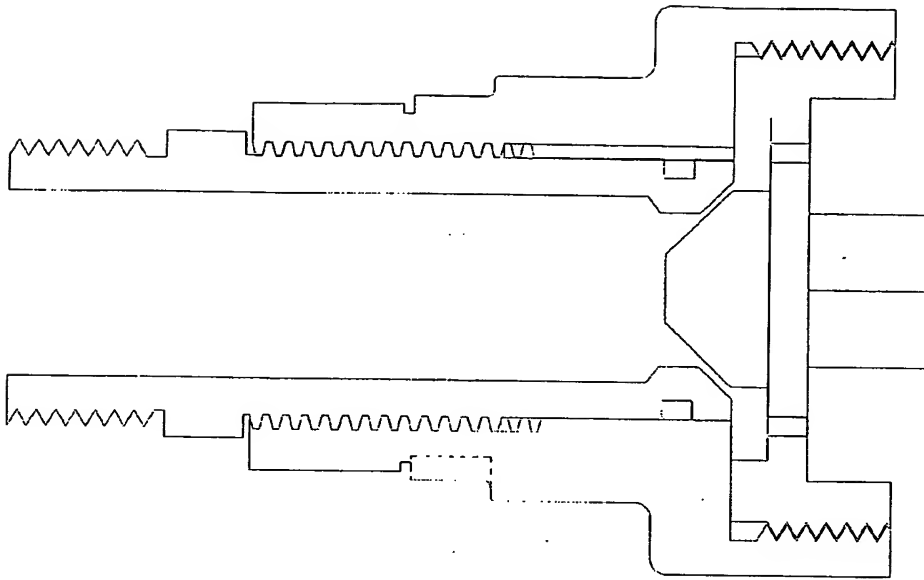


Center Gear Removal

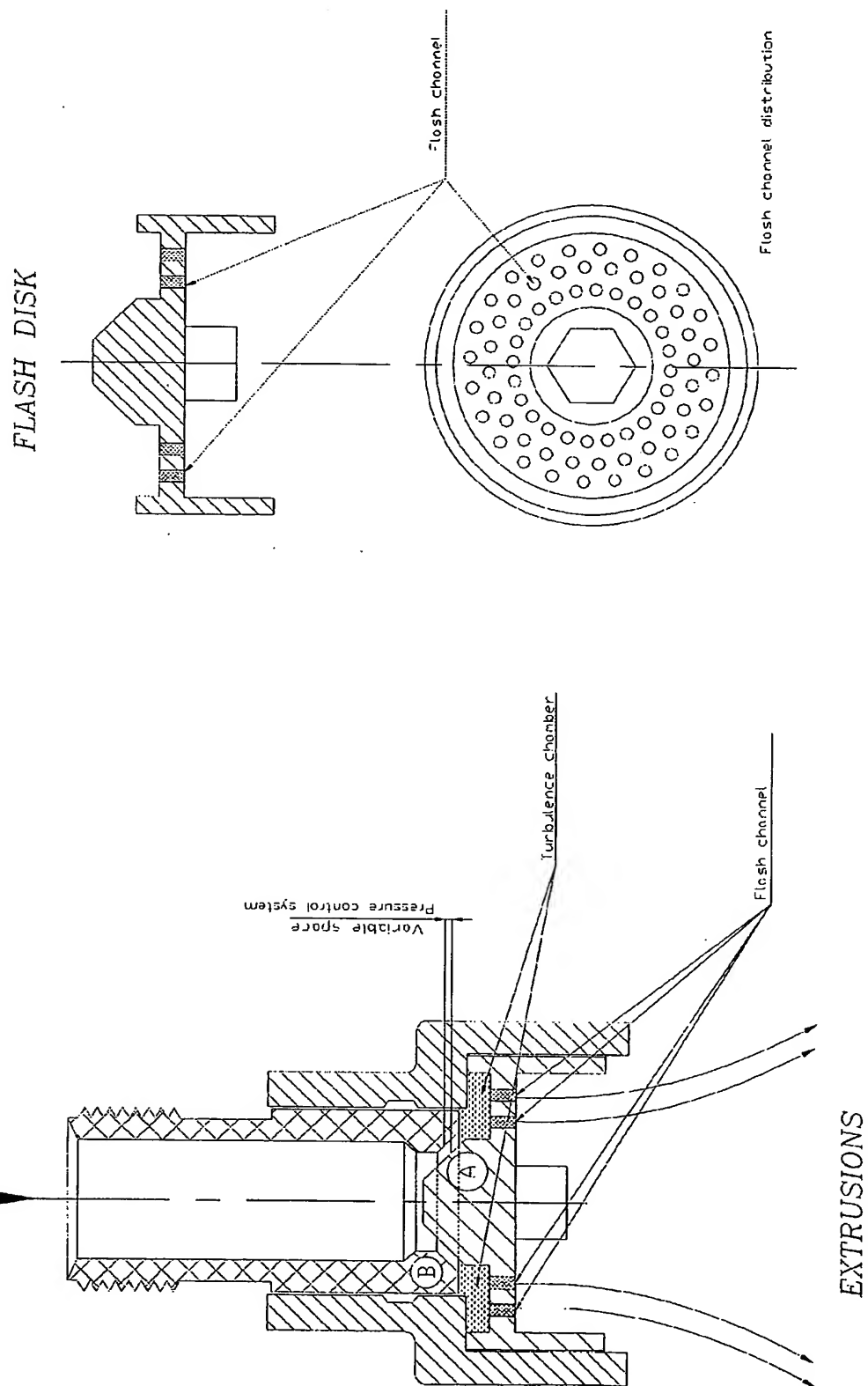


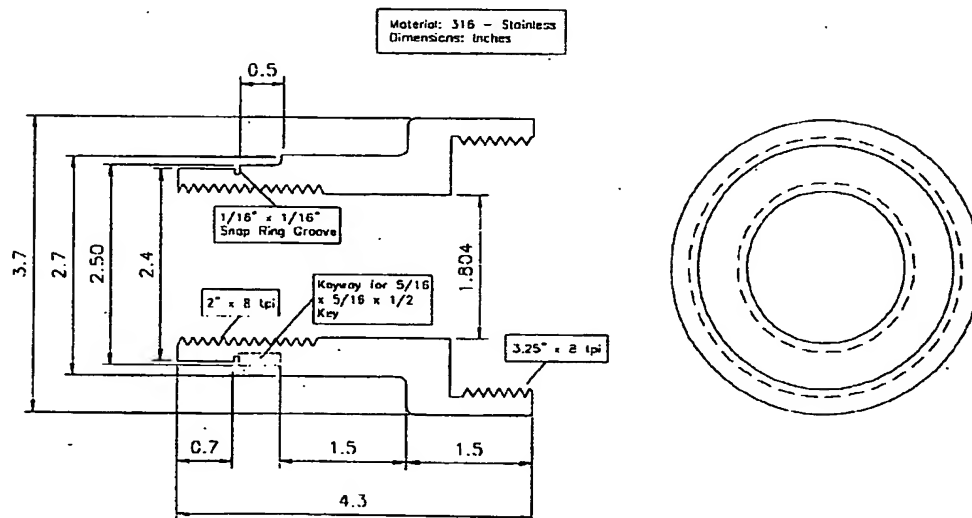
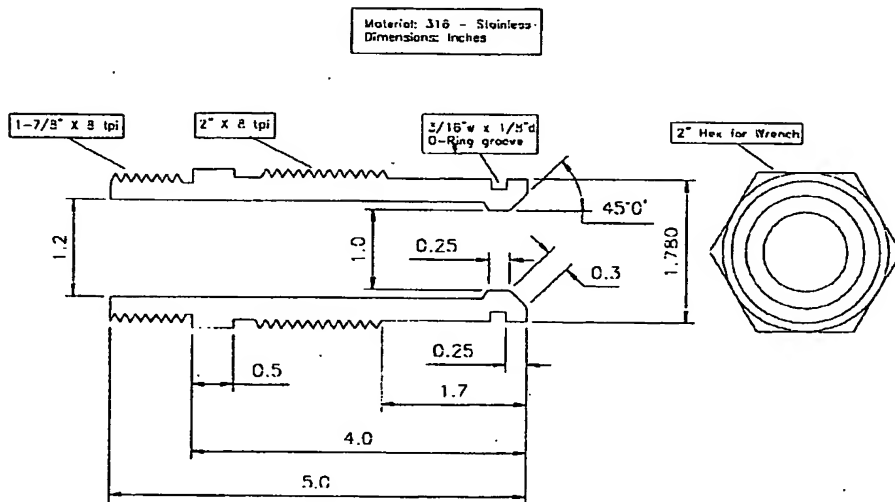
Adjustment sleeve & filter screen asse

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Cut away of Die body, adjustment sleeve, & Filter screen.

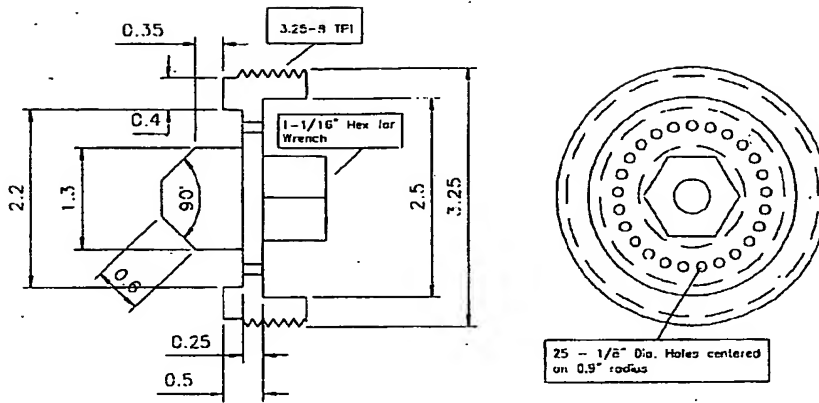




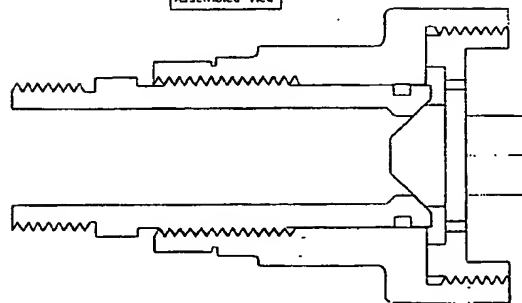


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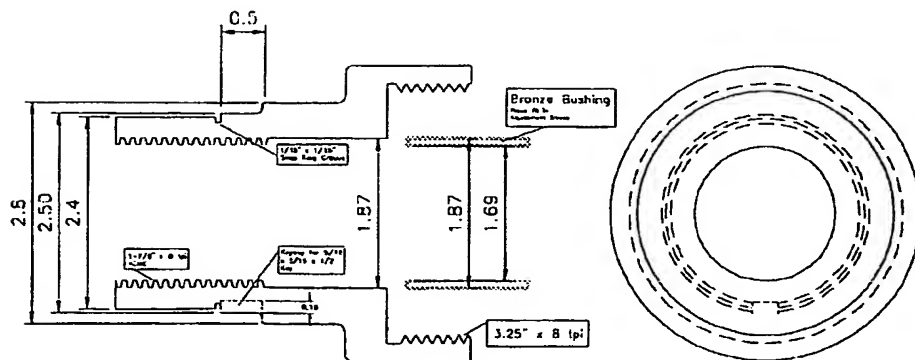
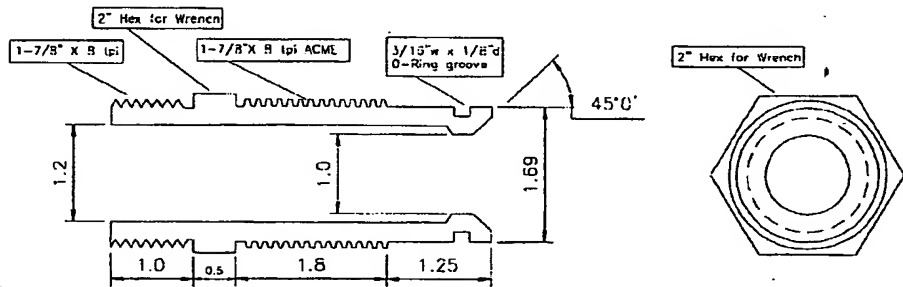
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Dimensions: Inches



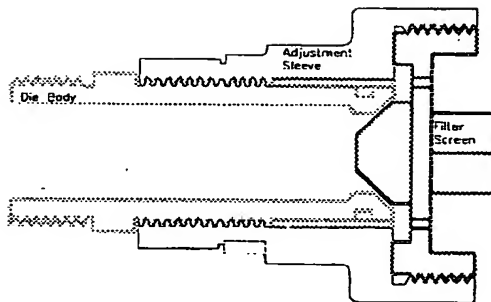
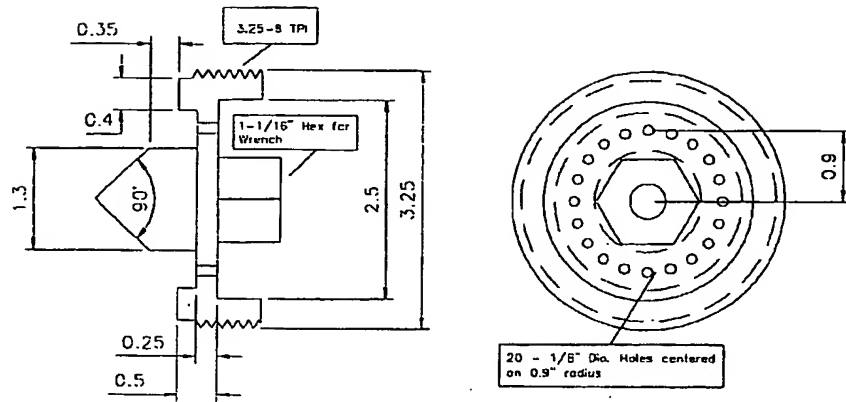
Assembled View



As Built & Used



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# Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/US04/016338

International filing date: 25 May 2004 (25.05.2004)

Document type: Certified copy of priority document

Document details: Country/Office: US  
Number: 60/474,445  
Filing date: 30 May 2003 (30.05.2003)

Date of receipt at the International Bureau: 19 August 2004 (19.08.2004)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)



World Intellectual Property Organization (WIPO) - Geneva, Switzerland  
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